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TRANSIT REFRIGERATION STUDIES WITH CALIFORNIA PREPACKAGED CARROTS

(A Progress Report)

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TRANSIT REFRIGERATION STUDIES WITH CALIFORNIA PREPACKAGED CARROTS

By

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SUMMARY AND CONCLUSIONS

Temperature records obtained in carloads of prepackaged carrots shipped in various containers and with different protective services show that this commodity is difficult to cool in transit. The middle layer of the load presents the greatest cooling problem. The need of maintaining commodity temperatures in transit, probably below 40° F. to prevent decay and insure an adequate shelf life for carrots, is indicated. Such temperatures were obtained in the middle layer of the loads in only a few of the shipments representing current commercial handling and shipping practices.

When shipped in cartons in fan cars without top ice, carrots that were not precooled remained above 50° F. in the middle layer of the load during most of the transit period in the summer, despite standard refrigeration and salt in transit. Precooling the carrots improved the transit temperature by shortening the time required to cool the middle layer of the load to 50° and lower. Carrots were precooled by hydrocooling before packaging or by icing the field trailers before dumping.

Warm carrots shipped in top-iced loads failed to cool satisfactorily in the middle layer when stacked 6 crates wide in nonfan cars but cooled very well with top ice in loads stacked 5 crates wide with channels between rows for additional ice. However, good cooling occurred in a conventional top-iced load 6 crates wide in a fan car. In top-iced cars, initial icing, one re-icing, and no salt provided adequate bunker refrigeration during the summer.

Non-precooled carrots cooled fairly fast in multiwall paper bags in top-iced chimney and modified chimney loads, but the bags became chafed and water soaked in transit. Carrots cooled before packaging carried well in bags in non-top-iced fan cars with initial icing and one re-icing in transit during cool weather.

These tests show that prompt cooling and low transit temperatures are necessary to insure an adequate shelf life for prepackaged carrots.

Further research is needed to determine the optimum transit temperature and minimum precooling requirement for prepackaged carrots and to evaluate methods of cooling, loading, and icing this commodity to obtain adequate protection in transit.

INTRODUCTION

The recent increase in shipments of prepackaged carrots from the Salinas-Watsonville district of California makes it desirable to determine the transit temperatures obtainable with this commodity in refrigerator cars. The carrots with tops removed are placed in 1-pound film bags and shipped in 24- and 48-pound master containers. Various containers and shipping practices are used commercially. Cooling prepackaged carrots in transit presents problems not encountered with bunched carrots, which are shipped with 15 to 20 pounds of crushed ice inside each crate and 5 to 6 tons per car "blown" over the top of the load.

OBJECTIVE

The purpose of this investigation was to determine the effect of current commercial handling and shipping practices on the transit temperature and shelf life of prepackaged carrots.

PROCEDURE

The test shipments included different shipping containers, various cooling and loading methods, and different railway protective services, table 1.

Containers

The shipping containers tested were fiberboard cartons of different kinds holding 24 bags each, wirebound crates of wood veneer containing 48 bags, and multiwall, wet-strength paper bags of 24- and 48-bag capacity. The crate and cartons are shown in figure 1. Table 2 shows the approximate size and shipping weight of all containers tested.

Loading practices

Each type of container was loaded according to the accepted practice. All cars contained "through" loads with no doorway bracing. Cartons Nos. 2, 4, and 6 were shipped in chimney loads with the cartons set alternately lengthwise and crosswise of the car, making hollow squares for circulation of air vertically through the load. Number 8 cartons were loaded solid with no spacing between rows or stacks. Crates were shipped in solid loads 6 crates wide, except in car 4 which was loaded 5 crates wide with 4-inch channels between rows. The paper bags were shipped in solid and chimney loads.

All containers were stacked to an even height of approximately 50 inches and met a railway minimum billing weight of 30,000 pounds per car.

Precooling practices

Some of the carrots shipped in cartons were precooled before packaging by hydrocooling them in ice water during the washing operation or by covering them with crushed ice while they stood in the field trailer at the packinghouse. Some carrots shipped in bags were cooled by adding ice to the wash tank or by precooling the load in the car.

Protective services

The railway protective services were those requested by the shipper. Cartons were shipped in pre-iced fan cars with standard refrigeration in transit and salt ranging from 2 to 4 percent of the ice supplied. Crates were top iced to a depth of 18 to 20 inches and shipped with initial bunker ice, one re-icing in transit, and no salt. All except one of the crate shipments were made in nonfan cars. The bags were shipped in top-iced and non-top-iced loads and in fan cars and nonfan cars.

Temperature data

Transit temperatures were obtained with small recording thermometers placed inside the shipping container with the carrots. The thermometers were located either in the bottom layer of the load near the ice bunker, in the middle layer of the quarterlength stack, and in the top layer near the doorway or only in the middle layer of the quarterlength stack representing the position most difficult to cool.

Market inspection

Condition of the loads was observed on arrival at the market to evaluate the carrying quality of the shipping containers and the effect of the various handling and shipping practices.

Shelf life of the carrots was determined by holding samples for 5 to 7 days at approximately 70° F. The samples were obtained from the same shipping containers that contained the thermometers so that the condition on arrival and during the holding period could be correlated with the transit temperature.

RESULTS

Comparison of transit temperatures in cartons and crates

Transit temperatures were obtained in 4 sets of cars comparing non-top-iced cartons and top-iced crates (tests 1, 3, 5, and 6).

In test 1 (fig. 2) made July 2 with carrots not previously cooled, the middle layer failed to cool in a load of No. 6 cartons in a non-top-iced fan car, and the middle layer cooled slowly in a load of No. 10 crates loaded solid 6 wide in a top-iced nonfan car. The top and bottom layer of the loads cooled fairly fast in both cars but remained above 40° F. during most of the transit period. As would be expected in top-iced cars, the top layer of the load, in

contact with ice, cooled faster than the bottom layer (car 1-B).

In test 3 (fig. 3), consisting of 3 cars shipped July 20, warm carrots in No. 10 crates stacked solid, 6 wide, cooled slowly in the middle layer of a top-iced nonfan car (car 3-A). With No. 2 cartons, warm carrots cooled fairly fast in the middle layer of a non-top-iced chimney load but did not reach 50° F. until the end of the trip (car 3-B). Carrots hydrocooled to 45° in ice water before packaging and shipped in No. 4 cartons (car 3-C) warmed slightly at first and then cooled slowly as the trip progressed. However, the temperature in the middle layer of the load was not above 55° during the entire trip.

In test 5 (fig. 4) comprising 3 cars shipped August 13 to 16, non-cooled carrots cooled quite rapidly to about 35° F. in all parts of a solid load of No. 10 crates, stacked 6 crates wide, in a top-iced fan car (car 5-A). The chimney load of No. 6 cartons in fan car 5-B was not top-iced, but the carrots in the load were cooled before packaging by icing the field trailers. Although the middle layer of this load cooled slowly in transit, the temperature was fairly low in the rest of the load. Fan car 5-C also was not top iced; it contained a solid load of No. 8 cartons containing non-cooled carrots. The middle layer of this load cooled fairly fast but remained above 50° for most of the trip.

Test 6 (fig. 5) consisted of two cars shipped August 23. No. 10 crates of non-cooled carrots were loaded solid, 6 crates wide, in top-iced nonfan car 6-A. The carrots in the chimney load of No. 6 cartons in non-top-iced fan car 6-B were precooled before packaging (like those in car 5-B) by icing the trailers at the packinghouse.

The middle layer of both loads cooled slowly in transit, but some benefit from icing the trailers is indicated by the slightly better transit temperature in car 6-B.

In these tests cartons cooled slowly in the middle layer of the load despite standard refrigeration and salt in transit. Slightly improved transit cooling occurred in No. 2 and No. 8 cartons (cars 3-B and 5-C) indicating that large chimney spaces through the load or ample ventilation of the cartons themselves are important factors in cooling warm carrots after loading in the car.

Transit temperatures were improved by removing excessive field heat from the carrots before they were packaged (cars 3-C, 5-B, and 6-B).

With crate shipments in top-iced loads, much better transit temperatures were obtained in the test with a fan car (car 5-A) than in those with nonfan cars (cars 1-B, 3-A, 6-A).

Comparison of transit temperatures in bags and crates

Transit temperatures in the middle layer in mixed loads of non-cooled carrots in which about 2/3 of the load was top-iced crates and the rest top-iced bags (test cars 2, 4, and 5-A) are shown in figure 6. The bags were 48-pound size. Each load was top-iced to a depth of 18 to 20 inches.

In car 2, a nonfan car shipped July 12, bags loaded in chimney pattern cooled more than crates loaded solid, 6 rows wide, probably because of the better penetration of top ice through the load in the bag portion of the car.

In car 4, a nonfan car shipped July 27, the crate portion of the car was loaded only 5 rows wide to compare the cooling in a channel-type load of crates and a chimney-type load of bags. With the top ice penetrating both parts of the load, fairly fast cooling occurred in the middle layer and there was little difference between the crate and bag portion of the load.

In car 5-A, a fan car shipped August 14 containing bags and crates loaded solid without chimney or channel spacing, the crates cooled faster than the bags, probably because of the more open construction of the crates.

In these tests transit cooling of top-iced crates and bags was improved in nonfan cars by channel- or chimney-type loading. Good cooling occurred in a non-channel load of crates shipped in a fan car.

Comparison of transit temperatures in different loads of bags

Transit temperatures in the middle layer of solid, chimney, and modified chimney loads of 48-pound bags in top-iced fan cars are shown in figure 7. The carrots were not cooled before packaging.

In cars 7 and 8 shipped October 6 and 9 containing chimney loads of No. 12 bags of carrots, the chimney pattern was modified in one end of the car by loading the bags solid along the walls and stacking them in chimneys only along the centerline. In both types of loads the middle layer cooled quite rapidly with top ice to temperatures near 40° F. or lower indicating effective cooling of the entire load.

In car 9, shipped October 11, containing a solid (non-channel) load of No. 12 bags of carrots in both ends, cooling was much slower than in the more open-type loads.

Transit temperatures in the middle layer of 3 modified chimney loads of 48-pound bags shipped in non-top-iced fan cars in November are shown in figure 8. The carrots were cooled to approximately 60° F. before packaging by adding crushed ice to the wash water. In these cars the carrots cooled fairly fast to 50° F. in the middle layer of the loads but did not drop below 40° in transit.

Transit temperatures in the middle layer of 3 solid (non-channel) loads of 24-pound bags shipped in non-top-iced fan cars in December are shown in figure 9. As in the previous test the carrots were cooled during the washing operation. They were precooled further in pre-iced cars by operating the car fans for approximately 5 hours. The bunker ice was not salted during the precooling operation. A comparison of the transit temperatures in cars 13, 14, and 15 with those in cars 10, 11, and 12 shows considerably slower cooling in the 24-pound bag loads stacked without channel spacing than in the 48-pound bags in modified chimney loads despite the extra precooling given the cars containing the 24-pound bags.

Condition on arrival and during holding period

Condition of the containers and loads on arrival at the market is shown in table 3. The wirebound crates in full loads of crates were all in good order at unloading, but when shipped in cars with bags, a few crates were damaged by shifting of the load in transit. Some paper bags in top-iced cars were damaged by water soaking and chafing. In non-top-iced loads, the bags carried well. The cartons generally were in good order except for occasional "part out" losses of content from poorly glued tops. Some of the telescope tops of No. 8 cartons came off in transit indicating the need of fasteners for this type of lid.

Except in car 1-A, decay reported by the receivers was of little consequence in the commercial loads. This car arrived with excessive decay despite seemingly adequate cooling in the top and bottom layers of the load, indicating an adverse field condition affecting the carrots.

Figure 10 shows the effect of transit temperature on the decay of carrots in 6 test cars. The samples came from the packages containing recording thermometers located in different parts of the loads. In car 1-B with carrots from 2 field lots located similarly in the car where the average transit temperature was 60° F., lot 1 decayed much less than lot 2, indicating considerable variation in shipping quality of carrots from different fields. In car 2, carrots from a single field decayed much more in the poorly cooled part of the load than in the part with better cooling. In car 4, carrots from one field carried well in all parts of the load with average temperatures in transit ranging from 40° to 50°. In car 5-A, with carrots from a single field lot, more decay developed in the sample at 51° than in those at lower temperatures. In car 5-B, more decay developed in carrots from the top and middle layers of the load, where the average transit temperature was 46° and 51° respectively, than in carrots from the bottom layer, where the temperature averaged 41°. In car 5-C average transit temperatures of 50° to 55° were fairly safe for this lot of carrots.

In these tests low transit temperatures checked decay and lengthened shelf life of weak carrots. A low transit temperature, and ways of obtaining it, seem to be more important than the type of shipping container.

Icing data

The ice supplied the test cars and estimates of the quantity remaining at destination are shown in table 4. The total ice supplied ranged from 30,000 to nearly 36,000 pounds. Most of the top-iced cars with modified icing service received 1 to 3 tons less ice than the non-top-iced cars with standard refrigeration and salt. All the cars arrived at the market with bunkers at least half full and most cars three-quarters full. The ice remaining on top-iced loads at destination varied from practically none to an even coverage of 10 inches, but apparently the initial supply was sufficient to protect the top layer of the loads.

Table 1.--Containers, types of loads, and railway protective services for prepackaged carrots in test cars

Test and car	Date shipped	Container[1/]	Load	Type of car	Railway protective service
1-A--	July 2	No. 6 cartons	Chimney	Fan	Pre-ice 4% salt; standard refrigeration, 3% salt.
1-B--	July 2	No. 10 crates	Solid	Nonfan	Top ice 18,000 lbs.; initial ice Salinas, re-ice Council Bluffs.
2----	July 12	No. 10 crates No. 12 bags	Solid Chimney	Nonfan	Top ice 21,000 lbs.; initial ice Roseville, re-ice Kansas City.
3-A--	July 20	No. 10 crates	Solid	Nonfan	Top ice 18,000 lbs.; initial ice Salinas, re-ice Council Bluffs.
3-B--	July 20	No. 2 cartons	Chimney	Fan	Pre-ice 3% salt; standard refrigeration, 3% salt.
3-C--	July 20	No. 4 cartons[2/]	Chimney	Fan	Pre-ice 2% salt; standard refrigeration, 3% salt.
4----	July 27	No. 10 crates No. 12 bags	Channel Chimney	Nonfan	Top ice 22,000 lbs.; initial ice Salinas, re-ice Kansas City.
5-A--	Aug. 14	No. 10 crates No. 12 bags	Solid Solid	Fan	Top ice 18,000 lbs.; initial ice Salinas, re-ice Kansas City.
5-B--	Aug. 16	No. 6 cartons[2/]	Chimney	Fan	Pre-ice 4% salt; standard refrigeration, 4% salt.
5-C--	Aug. 13	No. 8 cartons	Solid	Fan	Pre-ice 2% salt; standard refrigeration, 2% salt.
6-A--	Aug. 23	No. 10 crates	Solid	Nonfan	Top ice 18,000 lbs.; initial ice Salinas, re-ice Council Bluffs.
6-B--	Aug. 23	No. 6 cartons[2/]	Chimney	Fan	Pre-ice 4% salt; standard refrigeration, 4% salt.
7----	Oct. 6	No. 12 bags No. 12 bags	Chimney Modified chimney	Fan	Top ice 21,000 lbs.; initial ice Salinas, re-ice Council Bluffs.
8----	Oct. 9	No. 12 bags No. 12 bags	Chimney Modified chimney	Fan	Top ice 18,000 lbs.; initial ice Salinas, re-ice Council Bluffs.
9----	Oct. 11	No. 12 bags	Solid	Fan	Top ice 18,000 lbs.; initial ice Salinas, re-ice Council Bluffs.
10----	Nov. 6	No. 12 bags[2/]	Modified chimney	Fan	Pre-ice Salinas, re-ice Laramie.
11----	Nov. 10	No. 12 bags[2/]	Modified chimney	Fan	Pre-ice Salinas, re-ice Laramie.
12----	Nov. 26	No. 12 bags[2/]	Modified chimney	Fan	Pre-ice Salinas, re-ice Laramie.
13----	Dec. 4	No. 13 bags[2/]	Solid[3/]	Fan	Pre-ice Salinas, re-ice Laramie.
14----	Dec. 7	No. 13 bags[2/]	Solid[3/]	Fan	Pre-ice, replenish Salinas, re-ice Kansas City.
15----	Dec. 8	No. 13 bags[2/]	Solid[3/]	Fan	Pre-ice Salinas, re-ice Council Bluffs.

1/ See figure 1 and table 2 for description of containers.

2/ Carrots cooled before packaging.

3/ Loads precooled approximately 5 hours with car fan equipment.

Table 2.--Description of shipping containers for prepackaged carrots

Container reference No.	Kind	Capacity	Approximate outside dimensions 1/	Approximate shipping weight	Ventilation of container
		1-lb. bags	Inches	Lb.	
2	Fiberboard carton	24	9 x 18 x 10	31	1/4" slots in top, bottom, and sides
4	Fiberboard carton	24	11 x 16 x 10	33	1/4" slots in top, bottom, and sides
6	Fiberboard carton	24	12 x 19 x 7	32	1/4" slots in top, bottom, and sides
8	Fiberboard carton	24	15 x 16 x 7	30	Equivalent of five 1" holes in sides and ends.
10	Wood-veneer crate	48	15 x 23 x 9	61	1/2" slots in top, sides, bottom, and ends.
12	Paper bag 2/	48	14 x 28 x 8	56	Twelve 3/8" holes.
13	Paper bag 3/	24	12 x 24 x 6	30	Twelve 3/8" holes.

1/ In chimney loads the area of the vertical air space in each stack was approximately 9" x 9", 5" x 5" and 7" x 7" with cartons Nos. 2, 4, and 6, respectively, and 12" x 12" with bag No. 12.

2/ 3-ply, 60-lb., wet-strength kraft.

3/ 3-ply, 50-lb., wet-strength kraft.

Table 3.--Condition of commercial loads of carrots on arrival at the market

Test car	Date shipped	Date inspected	Market	Temperature of load near doorway at arrival		Containers	Remarks [1]
				Top	Bottom		
				° F.	° F.		
1-A	July 2	July 13	New York	55	52	No. 6 cartons	Few cartons slightly crushed.
1-B	July 2	July 12	New York	36	37	No. 10 crates [2]	Good order.
2	July 12	July 20	New York	41	40	No. 12 bags [2]	Paper water soaked, many friction holes.
				44	44	No. 10 crates [2]	Good order.
3-A	July 20	July 28	New York	36	44	No. 10 crates [2]	Good order.
3-B	July 20	July 28	New York	46	42	No. 2 cartons	27 cartons recoopered, 23 made good, 1 bad order, 3 empty.
3-C	July 20	July 27	New York	48	45	No. 4 cartons	1 carton broken.
4	July 27	Aug. 5	New York	36	--	No. 10 crates [2]	Few crates crushed.
				38	--	No. 12 bags [2]	10 bags badly torn, 18 badly scuffed.
5-A	Aug. 14	Aug. 23	New York	34	36	No. 10 crates [2]	Good order.
				35	41	No. 12 bags [2]	Good order.
5-B	Aug. 16	Aug. 29	New York	51	--	No. 6 cartons	Good order.
5-C	Aug. 13	Aug. 22	New York	43	--	No. 8 cartons	Many loose lids and some crushing.
6-A	Aug. 23	Sept. 1	New York	36	--	No. 10 crates [2]	Good order.
6-B	Aug. 23	Sept. 1	New York	39	--	No. 6 cartons	Good order.
7	Oct. 6	Oct. 18	Boston	34	38	No. 12 bags [2]	10 bags broken, 10 badly scuffed. No difference between chimney and modified chimney portions of load.
8	Oct. 9	Oct. 17	Philadelphia	36	37	No. 12 bags [2]	12 bags broken, 82 badly scuffed. No difference between chimney and modified chimney portions of load.
9	Oct. 11	Oct. 21	Pittsburgh	38	40	No. 12 bags [2]	19 bags broken, 38 badly scuffed.
10	Nov. 6	Nov. 14	Detroit	40	36	No. 12 bags	Good order.
11	Nov. 10	Nov. 17	Chicago	45	41	No. 12 bags	Good order.
12	Nov. 26	Dec. 5	Chicago	--	--	No. 12 bags	Good order.
13	Dec. 4	Dec. 12	Chicago	--	--	No. 13 bags	Good order.
14	Dec. 7	Dec. 15	New York	48	38	No. 13 bags	Good order.
15	Dec. 8	Dec. 16	Detroit	36	36	No. 13 bags	Good order.

1/ Carrots firm and bright. No decay reported on arrival except in car 1-A which contained 0 to 100 averaging 30 percent soft rot.

2/ Top-iced loads.

Table 4.--Icing record of test cars 1/

Test car	Date shipped	Top ice	Bunker ice and salt: Initial: Ice	Initial: Salt 2/	In transit: Ice	In transit: Salt 2/	Total ice	Ice remaining at destination: Top ice	Ice remaining at destination: Bunker ice
		Lb.	Lb.	Pct.	Lb.	Pct.	Lb.		
1-A	July 2	0	10,300	4	24,400	3	34,700	--	1/2 full
1-B	July 2	18,000	10,000	0	2,600	0	30,600	10" overall	3/4 full
2	July 12	21,000	10,600	0	2,000	0	33,600	Sparse	Not noted
3-A	July 20	18,000	10,000	3	3,300	3	31,300	8" - 10" spotty	3/4 full
3-B	July 20	0	11,500	2	21,700	3	33,200	--	3/4 full
3-C	July 20	0	10,000	0	20,700	0	30,700	--	3/4 full
4	July 27	21,000	11,500	0	1,200	0	33,700	8" overall	3/4 full
5-A	Aug. 14	18,000	10,000	0	4,200	0	32,200	8" - 10" spotty	1/2 full
5-B	Aug. 16	0	11,500	4	24,400	4	35,900	--	3/4 full
5-C	Aug. 13	0	11,500	2	18,500	2	30,000	--	7/8 full
6-A	Aug. 23	18,000	11,500	4	1,500	4	30,000	10" overall	3/4 full
6-B	Aug. 23	0	10,000	0	20,300	0	30,000	--	3/4 full
7	Oct. 6	21,000	11,500	0	1 re-icing	0	3/	4,000 lbs.	1/2 full
8	Oct. 9	18,000	11,500	0	1 re-icing	0	3/	6,000 lbs.	1/2 full
9	Oct. 11	18,000	11,500	0	1 re-icing	0	3/	10" - 12" overall	7/8 full
10	Nov. 6	0	11,500	0	1 re-icing	0	3/	--	1/2 full
11	Nov. 10	0	11,500	0	1 re-icing	0	3/	--	1/2 full

1/ No records obtained for cars 12 to 15, inclusive.
2/ Percent of ice supplied.
3/ Amount supplied at re-icing station not obtained from railroads.

Figure 1.--Crate No. 10 and cartons Nos. 2, 4, 6, and 8 used for prepackaged carrots.

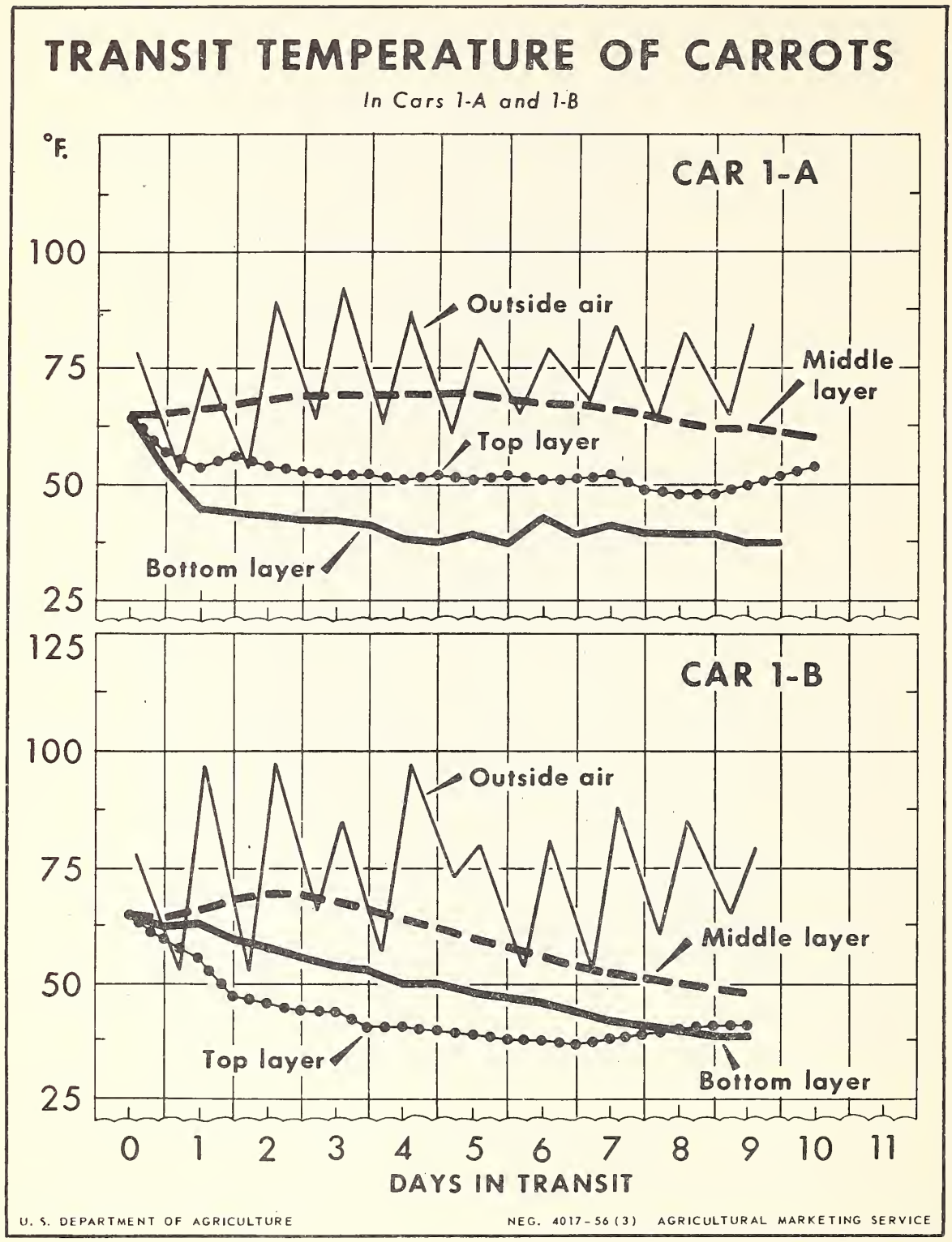

Figure 2.--Car 1-A: Chimney load of No. 6 cartons of non-precooled carrots in non-top-iced fan car. Car 1-B: Solid load of No. 10 crates of non-precooled carrots in top-iced nonfan car.

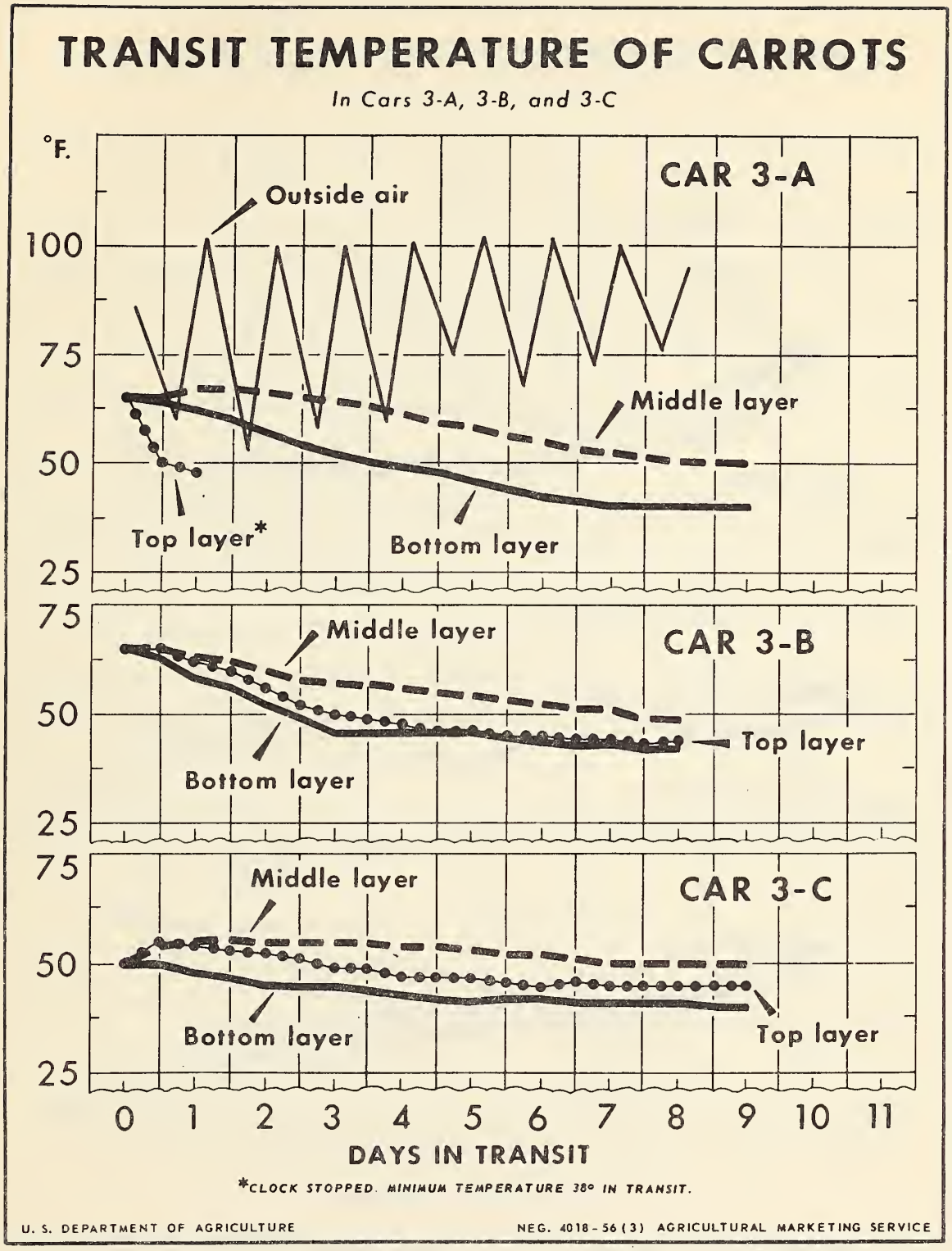

Figure 3.--Car 3-A: Solid load of No. 10 crates of non-precooled carrots in top-iced nonfan car. Car 3-B: Chimney load of No. 2 cartons of non-precooled carrots in non-top-iced fan car. Car 3-C: Chimney load of No. 4 cartons in non-top-iced fan car; carrots hydrocooled before packaging.

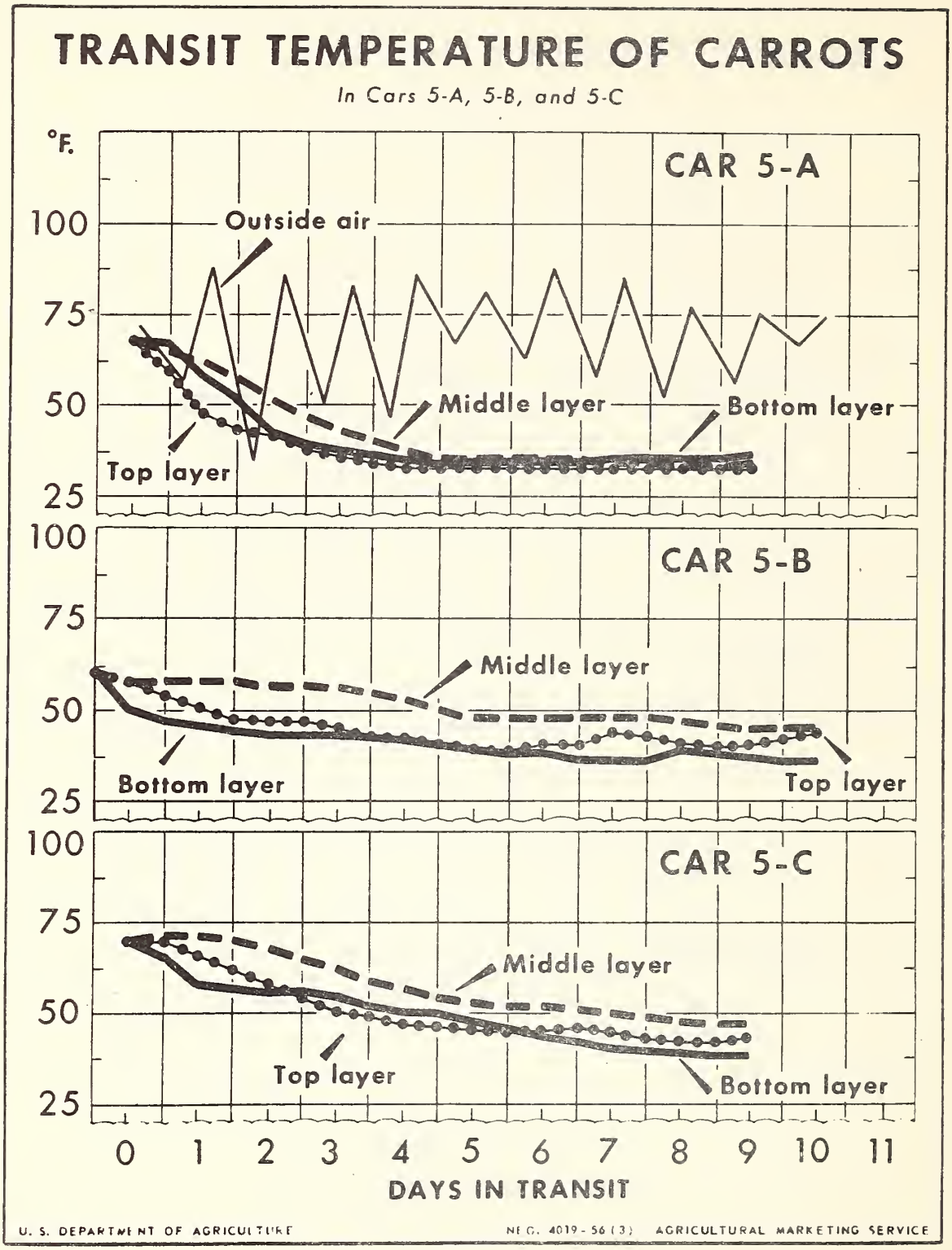

Figure 4.--Car 5-A: Solid load of No. 10 crates of non-precooled carrots in top-iced fan car. Car 5-B: Chimney load of No. 6 cartons in non-top-iced fan car; carrots cooled by ice in field trailers at packinghouse. Car 5-C: Solid load of No. 8 cartons of non-precooled carrots in non-top-iced fan car.

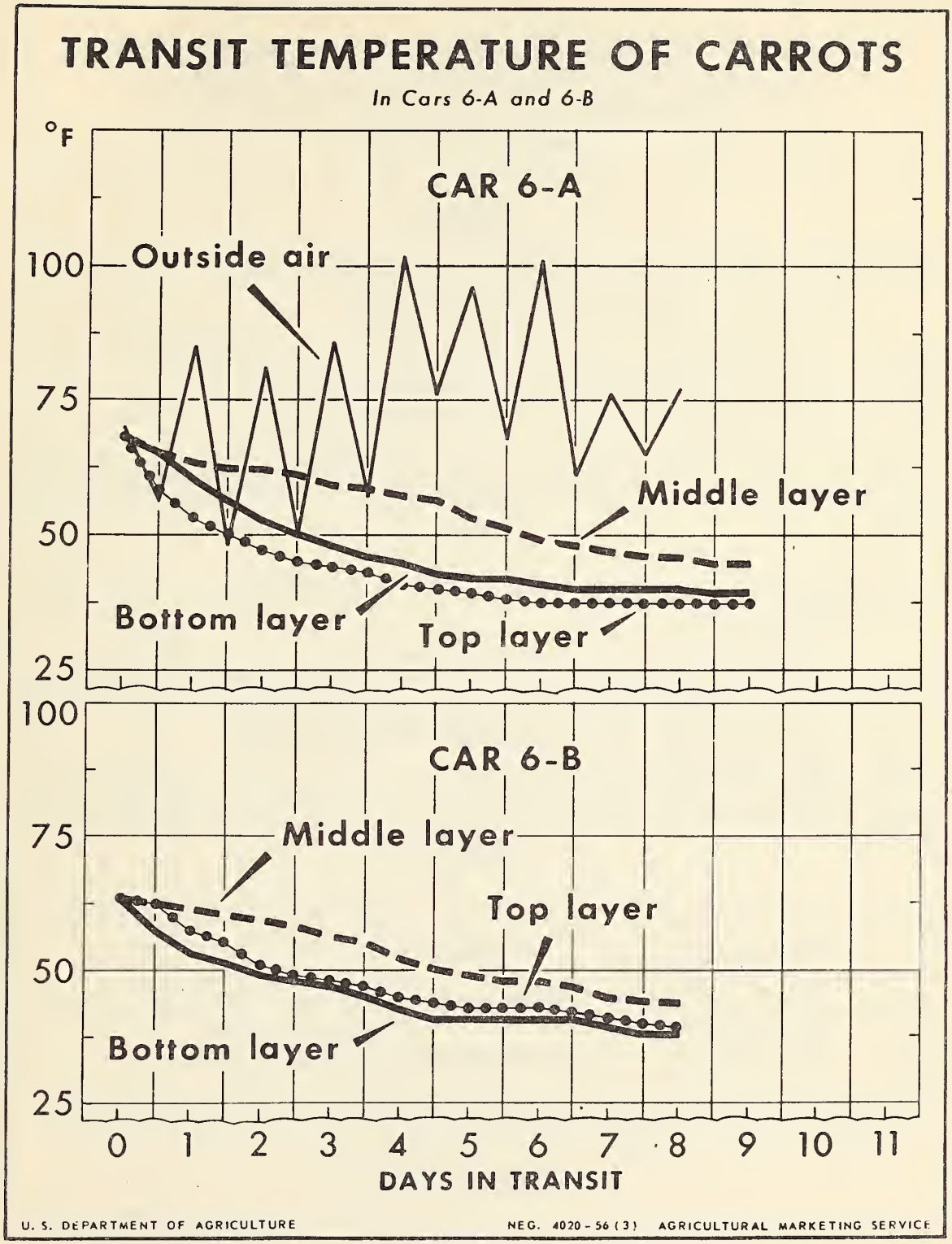

Figure 5.--Car 6-A: Solid load of No. 10 crates of non-precooled carrots in top-iced nonfan car. Car 6-B: Chimney load of No. 6 cartons in non-top-iced fan car; carrots cooled by ice in field trailers at packinghouse.

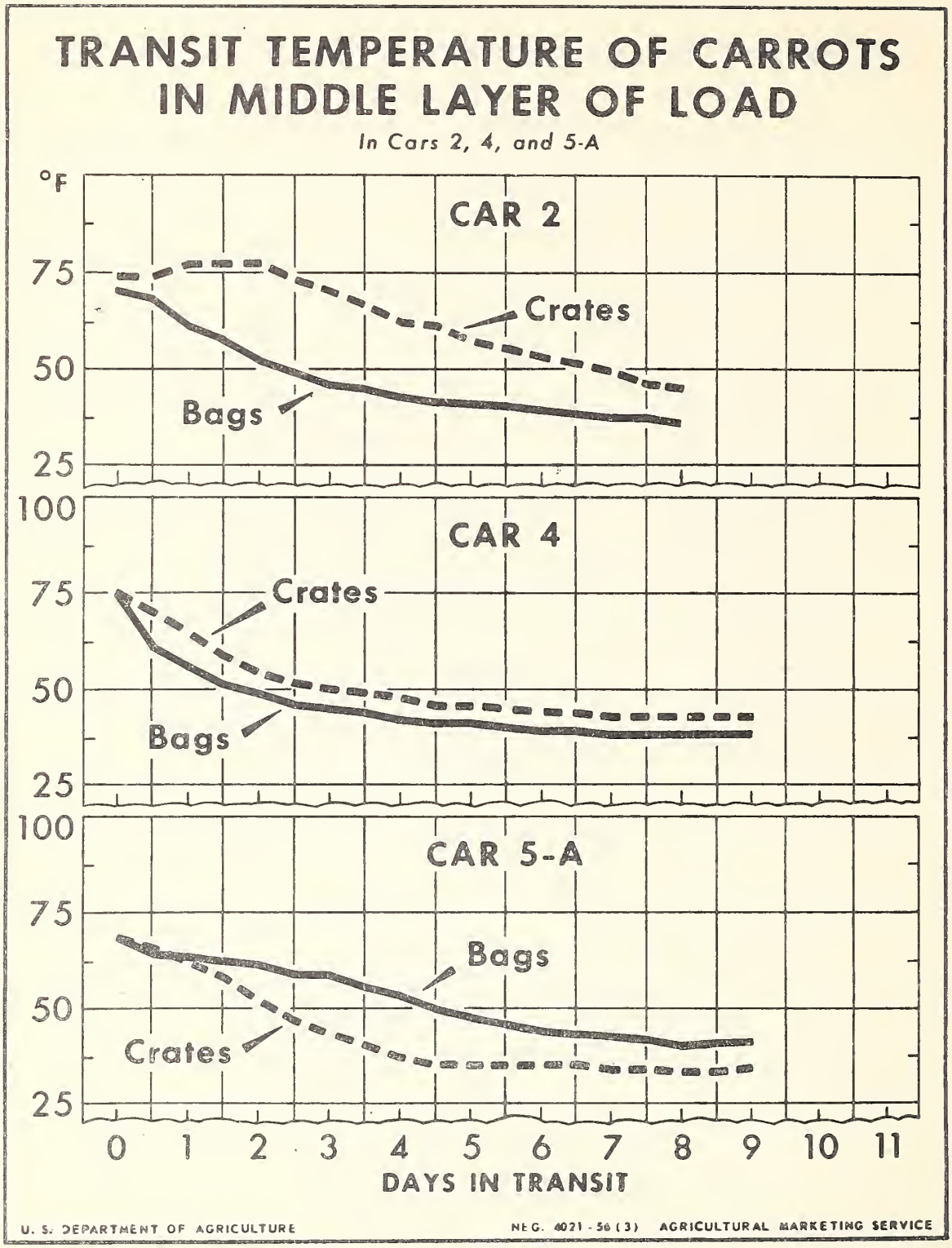

Figure 6.--Car 2: Solid load of No. 10 crates vs. chimney load of No. 12 bags in same top-iced nonfan car. Car 4: Channel load of No. 10 crates vs. chimney load of No. 12 bags in same top-iced nonfan car. Car 5-A: Solid load of No. 10 crates vs. solid load of No. 12 bags in same top-iced fan car.

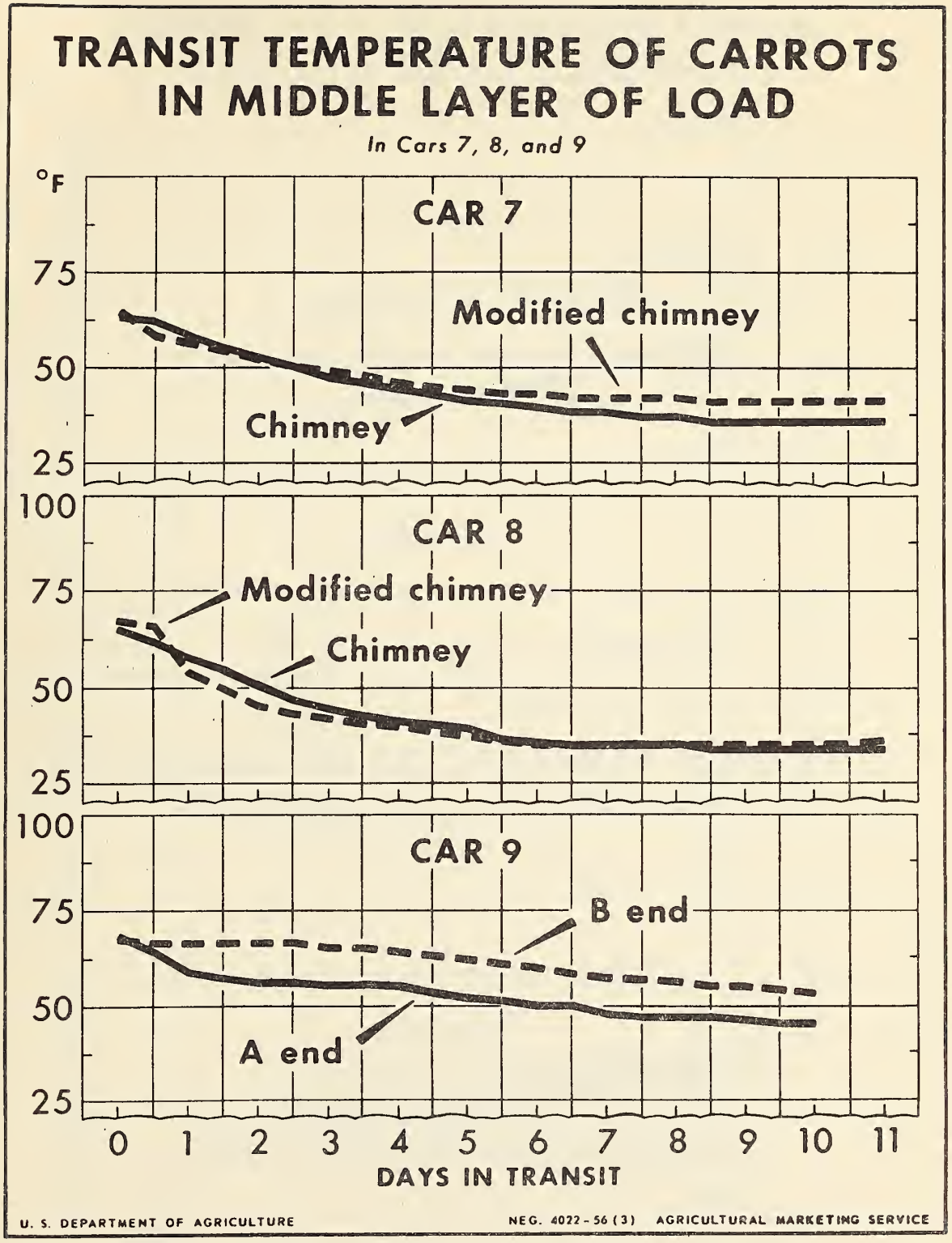

Figure 7.--Car 7: Chimney vs. modified chimney loads of No. 12 bags in same top-iced fan car. Car 8: Chimney vs. modified chimney loads of No. 12 bags in same top-iced fan car. Car 9: Solid loads of No. 12 bags in both ends of same top-iced fan car.

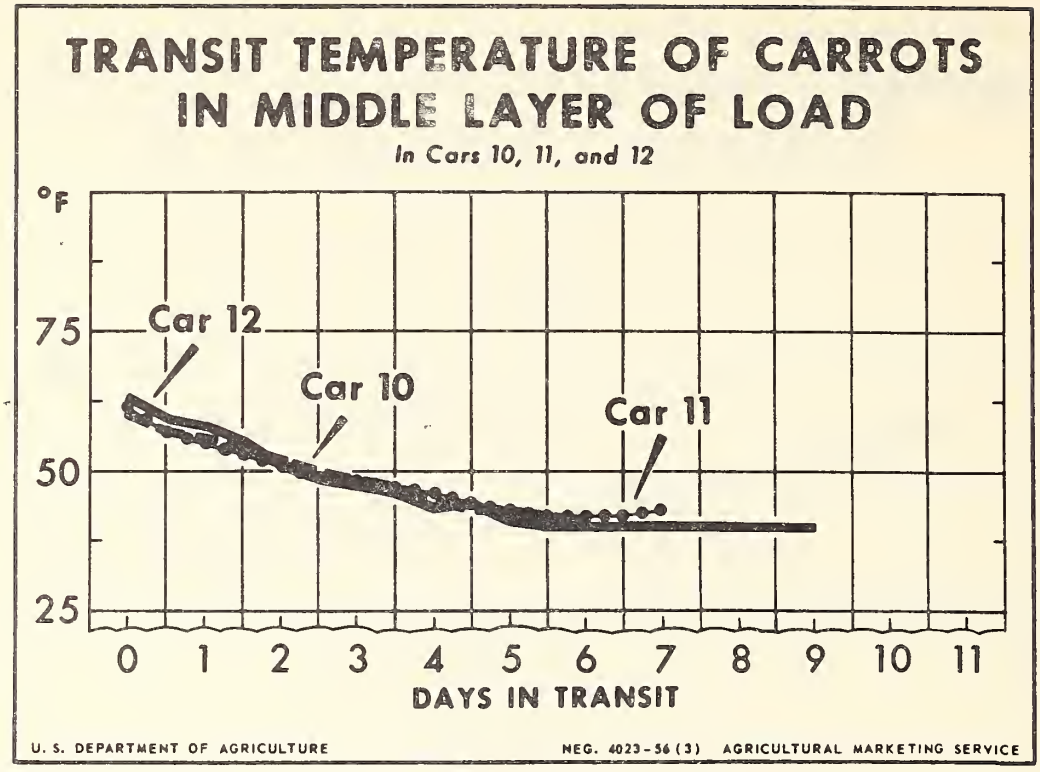

Figure 8.--Modified chimney loads of No. 12 bags in three non-top-iced fan cars. Carrots cooled by ice added to washing tank.

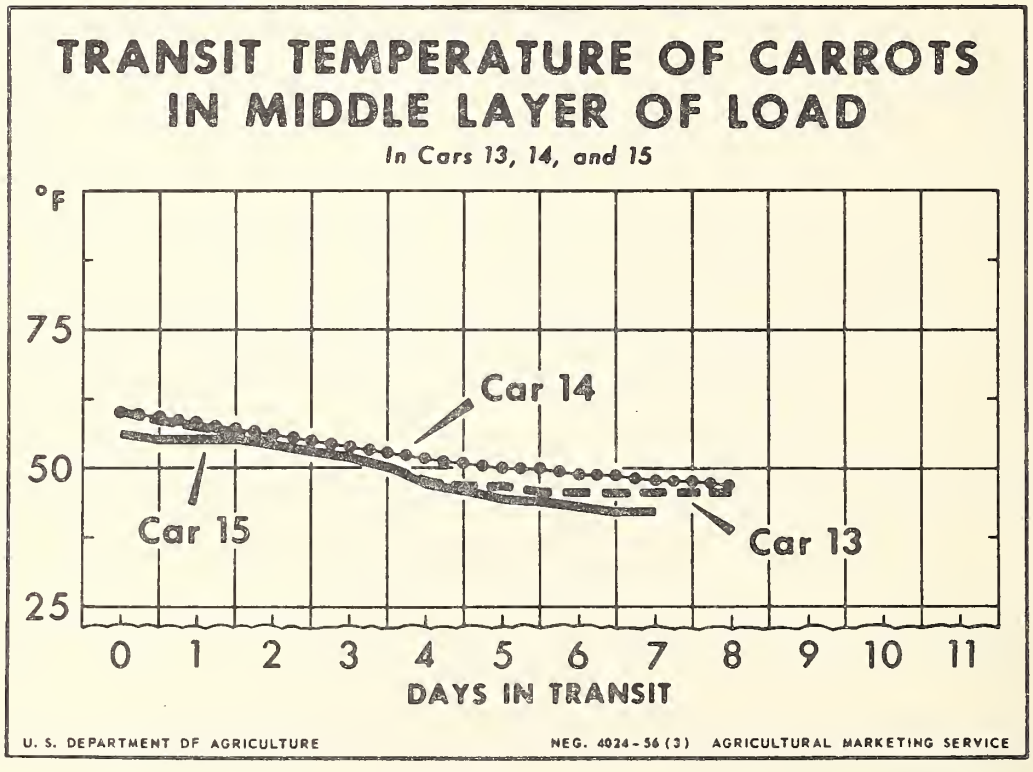

Figure 9.--Solid loads of No. 13 bags in three non-top-iced fan cars. Carrots cooled by ice added to washing tank. Loads pre-cooled in car.

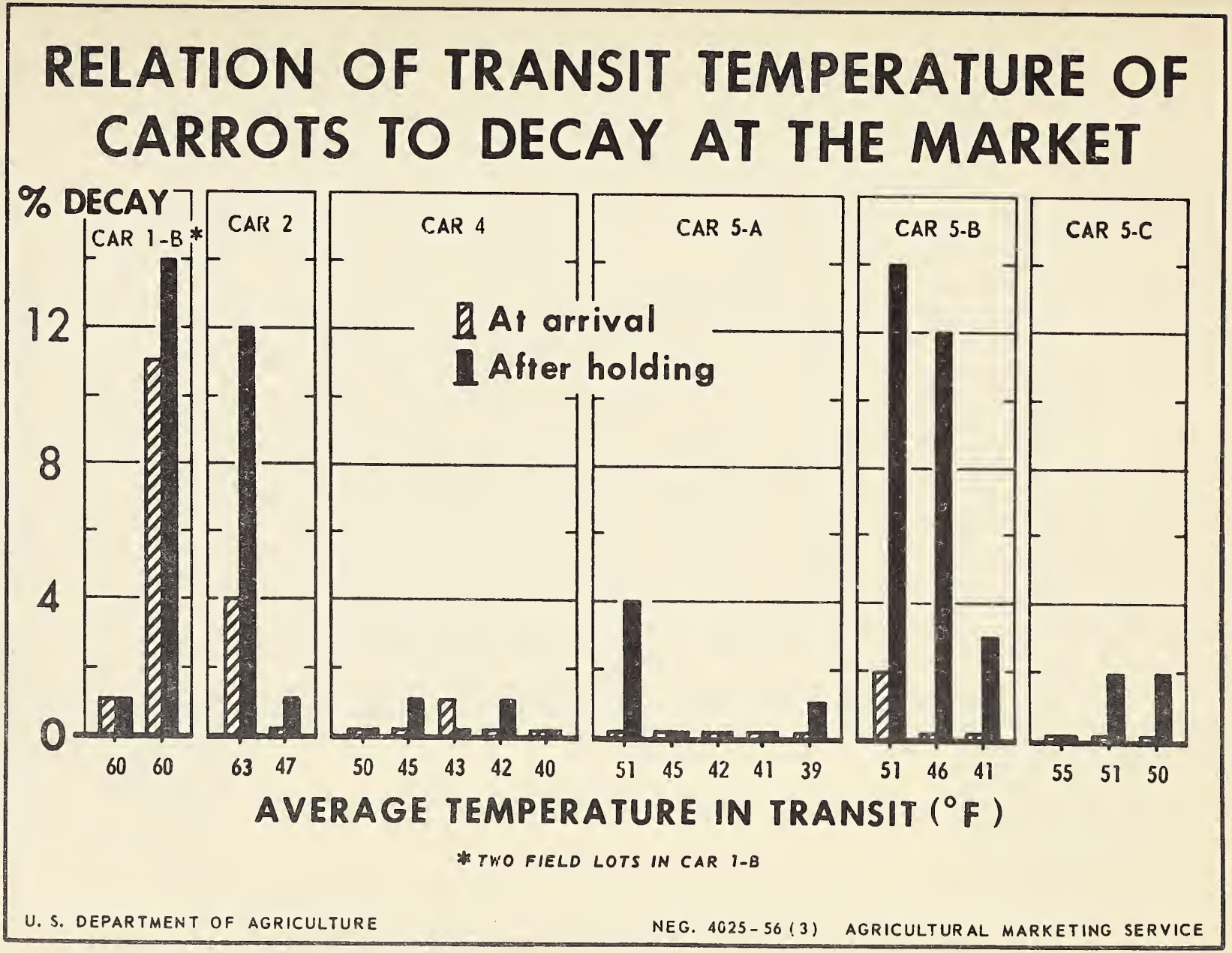
RELATION OF TRANSIT TEMPERATURE OF CARROTS TO DECAY AT THE MARKET
% DECAY
CAR 1-B *
CAR 2
CAR 4
CAR 5-A
CAR 5-B
CAR 5-C
At arrival
After holding
12
8
4
0
60 60
63 47
50 45 43 42 40
51 45 42 41 39
51 46 41
55 51 50
AVERAGE TEMPERATURE IN TRANSIT (°F)
* TWO FIELD LOTS IN CAR 1-B
U. S. DEPARTMENT OF AGRICULTURE
NEG. 4025-56 (3) AGRICULTURAL MARKETING SERVICE

Figure 10